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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/871,463	05/31/2001	Charles R. Spinner III	01-P-002 (STMI01-00013)	9805
30425 7590 04/20/2007 STMICROELECTRONICS, INC. MAIL STATION 2346 1310 ELECTRONICS DRIVE CARROLLTON, TX 75006			EXAMINER WARREN, MATTHEW E	
			ART UNIT	PAPER NUMBER
			2815	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/20/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

09/871,463

Applicant(s)

SPINNER ET AL.

Examiner

Matthew E. Warren

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 25 January 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) 1-7 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 8-11, 13-20 is/are rejected.
- 7) ☒ Claim(s) 12 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: _____

DETAILED ACTION

This Office Action is in response to the Amendment filed on January 25, 2007.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 16-19, as far as understood, are rejected under 35 U.S.C. 102(b) as being anticipated by Suzuki et al. (US 6,054,383)

In re claim 16, Suzuki et al. shows (fig. 2C) a portion of an integrated circuit structure comprising: a dielectric layer (4) having an opening, tungsten (8a) within the opening and filling a majority of a depth of the opening across a width of the opening, an upper surface of the tungsten within a central region of the width of the opening below an upper surface of the dielectric layer, and a portion of an etch protective barrier layer (10a) over a central region of the tungsten and within the opening, but not over peripheral regions of the tungsten with the opening. The protective barrier layer has the property of a material for which removal of chemical mechanical polishing is primarily mechanical (col. 6, lines 59-65) .

In re claim 17, Suzuki et al. shows (fig. 2C) that an upper surface of the tungsten is exposed around a portion of the protective barrier layer.

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In re claim 18, Suzuki et al. discloses (col. 5, lines 62-67) that the protective barrier layer is titanium or titanium nitride.

In re claim 19, Suzuki et al. shows (fig. 2C) that the tungsten outside the central region of the opening and the portion of the protective barrier layer form an upper surface, which is planar with an upper surface of the dielectric layer.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 8-11, 13, and 14, as far as understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Marcyk et al. (US 6,103,625) in view of Suzuki et al. (US 6,054,383).

In re claim 8, Marcyk et al. shows (fig. 2B) a portion of an integrated circuit comprising: a dielectric layer (202) over a substrate, a conformal tungsten layer (206) over the dielectric layer, within and filling any unfilled portions openings within the dielectric layer. An etch protective barrier (208) of tungsten is formed over the tungsten layer and the openings. Marcyk shows all of the elements of the claims except the etch protective barrier comprising a material for which removal by chemical mechanical polishing is primarily mechanical. Suzuki et al. shows (fig. 2B) a portion of an integrated circuit structure comprising: a dielectric layer (4) having an opening, tungsten (8a) within

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the opening, and an etch protective barrier layer (10a) over the tungsten. The etch protective barrier layer is a TiN layer and has the property of a material for which removal of chemical mechanical polishing is primarily mechanical (col. 6, lines 51-65). By using this material, the conductive layer is effectively prevented from being chemically etched by chemicals during the CMP process. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the etch protective barrier of Marcyk by using a material for which removal by CMP is primarily mechanical (such as TiN) as taught by Suzuki to prevent the underlying conductive layer from being etched away chemicals during the CMP process.

In re claim 9, Suzuki discloses (col. 5, lines 62-67) that the etch protective barrier is titanium nitride.

In re claim 10, Suzuki shows (fig. 2B) that the portions of the tungsten layer within the openings are thicker than the portions of the tungsten layer over the dielectric layer.

In re claim 11, Marcyk shows (fig. 2B) that the etch protective barrier layer (208) overlies the entire tungsten layer (206).

In re claims 13, neither reference specifically discloses the thickness within the desired range, however, it would have been obvious to one of ordinary skill in the art to make the thickness of the tungsten layer within the desired range, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233. One of ordinary skill in the art would have been motivated to form

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the tungsten have the thickness within the desired range to form the device having specific dimensions.

In re claim 14, Suzuki discloses (col. 6, lines 1-2) that the protective barrier layer has a thickness of 0.05 microns (500 Angstroms), which is between 100 and 800 Angstroms.

Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Marcyk et al. (US 6,103,625) in view of Suzuki et al. (US 6,054,383) as applied to claim 8 above, and further in view of Van Buskirk et al. (US 6,346,741 B1).

In re claim 15, Marcyk and Suzuki show all of the elements of the claims except the opening in the dielectric being sized to form a capacitive electrode from the tungsten within the opening. Van Buskirk et al. shows. (fig. 1H) shows a capacitor device comprising a tungsten electrode contact (18) and a tungsten top electrode (44) formed in dielectric layer (18 and 35) openings. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the tungsten interconnect of Marcyk and Suzuki by incorporating that interconnect as a capacitor electrode because Van Buskirk teaches that tungsten interconnects suitably function as capacitor electrodes.

Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki et al. (US 6,054,383) as applied to 16 above, and further in view of Van Buskirk et al. (US 6,346,741 B1).

In re claims 20, Suzuki et al. shows all of the elements of the claims except the opening in the dielectric being sized to form a capacitive electrode from the tungsten within the opening. Van Buskirk et al. shows. (fig. 1H) shows a capacitor device comprising a tungsten electrode contact (18) and a tungsten top electrode (44) formed in dielectric layer (18 and 35) openings. Therefore it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the tungsten interconnect of Suzuki by incorporating that interconnect as a capacitor electrode because Van Buskirk teaches that tungsten interconnects suitably function as capacitor electrodes.

Allowable Subject Matter

Claim 12 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The prior art references do not show that the etch protective barrier layer overlies a portion of the tungsten layer within the openings but not portions of the tungsten layer over the dielectric layer. As shown in figure 2c of Marcyk, the tungsten layer has been etched down and no longer is formed over the dielectric layer; only within the opening of the dielectric layer. Although the etch protective barrier (208b) of Marcyk is formed over only the tungsten layer within the opening, there is no conformal tungsten layer formed over other parts of the dielectric. Therefore, Marcyk cannot satisfy the limitations of the claim 12 and independent claim 8. The limitations of claim 12 pertain to figure 1B of the applicant's specification.

Response to Arguments

Applicant's arguments filed with respect to claims 8-20 have been fully considered but they are not persuasive. The applicant primarily asserts that the prior art references do not show all of the elements of the claims, specifically that Suzuki does not disclose the added limitation of the tungsten filling a majority of the depth of the opening and that Marcyk and Suzuki does not teach that the etch protective barrier has the property listed in the claims. The examiner believes that the cited references show all of the elements of the claims and that the rejection is still proper.

In re the arguments against the 35 USC 102 rejection of claims 16-19, the examiner believes that the Suzuki shows the amended limitations in question. The applicant asserts that Suzuki does not show the feature of the tungsten layer filling the majority of the opening, however, the applicant does not supply any evidence cited in Suzuki that such assertion is the case other than the fact Suzuki does not describe the tungsten layer filling a majority of the depth of the opening. The examiner believes that based on the drawings of Suzuki (fig. 2C), the limitation in question, has been met simply for the fact that the tungsten layer (8a) is filled in the entire opening. It is understood that the etch protective barrier (10a) also fills a small portion of the depth in a central region of the tungsten, however the tungsten layer is formed throughout the entire depth and therefore fills the majority of the depth of the opening. Therefore, Suzuki shows all of the elements of the claims and the 35 USC 102 rejection above is proper.

In re the arguments against the 35 USC 103 rejection of claims 8-15 over Marcyk in view of Suzuki et al., the examiner believes that this rejection is also proper. The applicant asserts that because Suzuki teaches that TiN, amongst other materials, is used as a polish stop layer, then Suzuki does not properly teach the limitation of a material for which removal is by chemical mechanical polishing is primarily mechanical and thus cannot cure the deficiencies of Marcyk. As stated in the rejection above, Suzuki teaches the benefits of using these materials in conjunction with tungsten. By using the materials listed, the underlying conductive layer (tungsten) is effectively prevented from being chemically etched by chemicals during the CMP process (col. 6, lines 51-65). Therefore, Marcyk and Suzuki shows the proper motivation for combining and show all of the elements of the claims. For these reasons, the rejection is still proper and this office action is made final.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

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the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew E. Warren whose telephone number is (571) 272-1737. The examiner can normally be reached on Mon-Thur and alternating Fri 9:00-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Parker can be reached on (571) 272-2298. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew E. Warren



April 6, 2007